Name: _____ (please print)

Signature: _____

ECE 2202 Quiz 5
December 1, 2020
Online

1. This quiz is open book, open notes.
2. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order will lose credit.
3. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
4. If the grader has difficulty following your work because it is messy or disorganized, you will lose credit.
5. Do not use red ink. Do not use red pencil.
6. You will have 30 minutes to work on this quiz, and 15 minutes to download/print, scan and submit.
7. You MUST use LOWER-CASE letters for time domain variables, and UPPER-CASE LETTERS WITH AN OVERBAR for phasor domain variables. Significant credit will be subtracted if you do not follow this rule.

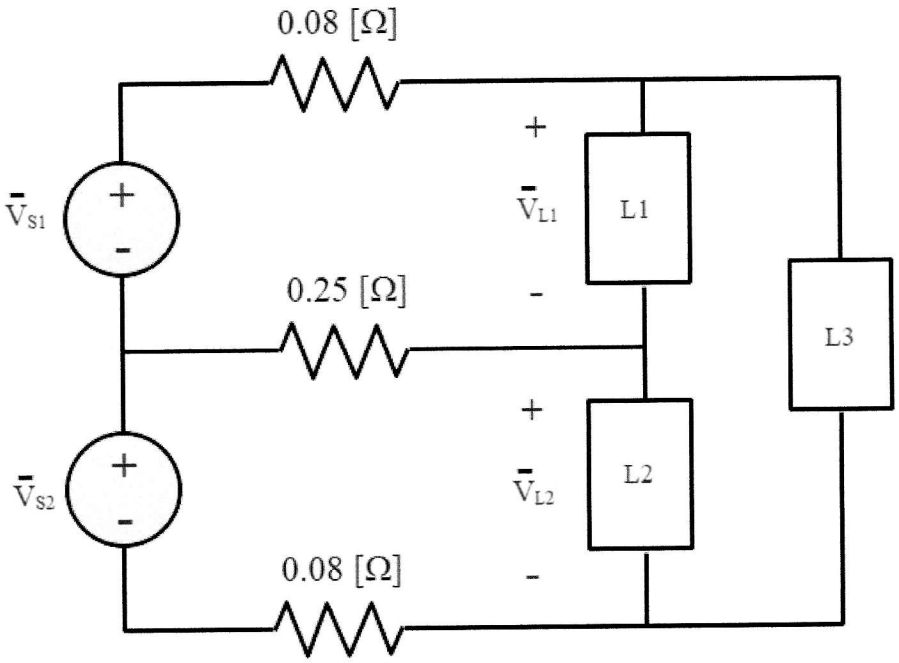
_____/25

Room for extra work

The circuit below is operating in steady-state, and the voltage sources $\bar{V}_{S1}$ and $\bar{V}_{S2}$ are sinusoidal. The load voltage are $\bar{V}_{L1} = \bar{V}_{L2} = 125\angle 0°\,[V_{rms}]$.

Load L1 absorbs 5 [kW] at 0.9285 lagging.
Load L2 absorbs 3.75 [kW] and 1.25 [kVAR].
Load L3 is a resistor of 80 [Ω].

Find the complex power delivered to the circuit by source $\bar{V}_{S1}$.



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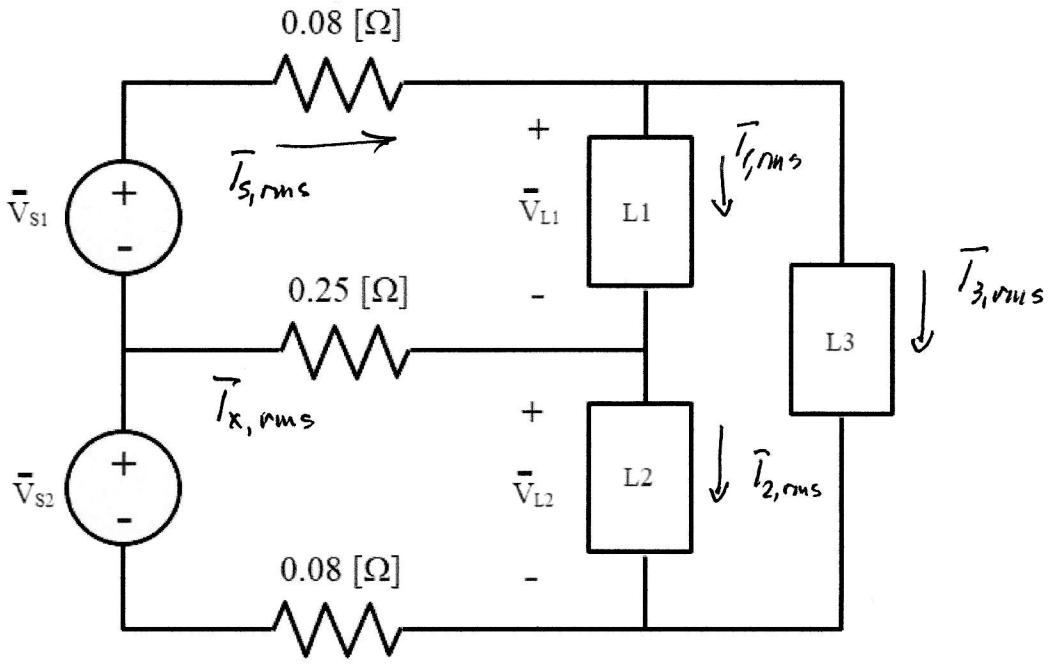

The game plan is to find the currents in the loads using the information about S for each of them. From there we can find $\bar{I}_{S,rms}$ and $\bar{I}_{X,rms}$ and then KVL will give us $\bar{V}_{S1}$. We will do everything in rms units.

L_1: $P = 5000$ [W] @ 0.9285 $\Rightarrow |S_1| = \frac{5000}{0.9285} = 5385$ [VA]

So $S_1 = 5000 + j\,5385\,(rf) = 5000 + j\,2000$ [VA]

$rf = \sqrt{1 - 0.9285^2} = 0.3713$

Room for extra work

$$S_1 = \bar{V}_{L1} \cdot \bar{I}_{1,rms}^{*} \Rightarrow \bar{I}_{1,rms}^{*} = \frac{S_1}{125} = \underset{43.08\angle 21.8^\circ}{40+j16} \quad [A_{rms}]$$

$$\Rightarrow \bar{I}_{1,rms} = \underset{43.08\angle -21.8^\circ}{40-j16} \quad [A_{rms}]$$

L_2: $S_2 = 3750 + j1250$ [VA] $\Rightarrow \bar{I}_{2,rms}^{*} = \frac{S_2}{125} = \underset{31.62\angle 18.44^\circ}{30+j10}$ $[A_{rms}]$

$$\Rightarrow \bar{I}_{2,rms} = \underset{31.62\angle -18.44^\circ}{30-j10} \quad [A_{rms}]$$

L_3: $\bar{I}_{3,rms} = \frac{250}{80} = 3.125$ $[A_{rms}]$

$$\bar{I}_{S,rms} = \bar{I}_{1,rms} + \bar{I}_{3,rms} = \underset{46\angle -20.36^\circ}{43.125 - j16} \quad [A_{rms}]$$

$$\bar{I}_{x,rms} = \bar{I}_{2,rms} - \bar{I}_{1,rms} = \underset{11.66\angle 149^\circ}{-10+j6} \quad [A_{rms}]$$

$$\bar{V}_{S1} = 0.08\,\bar{I}_{S,rms} + 125 + (-\bar{I}_{x,rms})\,0.25 = \underset{130.98\angle -1.22^\circ}{130.95 - j2.78} \quad [V_{rms}]$$

Finally,

$$S_{del\ by\ V_{S1}} = \bar{V}_{S1} \cdot \bar{I}_{S,rms}^{*} = \underset{6024.7\angle 19.14^\circ}{5691.7 + j1975.3} \quad [VA]$$